



# **Armed Forces College of Medicine AFCM**

# CEREBELLUM



**Integrated**

**Physiology**

**Medicine**

# INTENDED LEARNING OBJECTIVES (ILO)



## **By the end of this lecture the student will be able to:**

- Describe the clinical features of patients presenting with cerebellar disorders
- Use physiological basis to explain manifestations of cerebellar ataxia
- Compare motor and sensory ataxia.
- Use Integrated basic knowledge of the cerebellum in diagnostic reasoning of cerebellar disorders.



# **Physiology & Medicine**

**Prof. Dr. Samar El Ghotny**

***Professor of Physiology***

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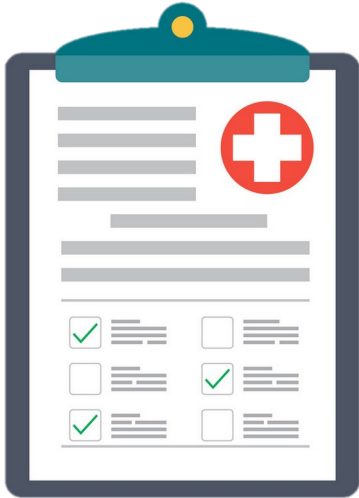
***Lecturer of Internal Medicine***

# Functions & Lesions

# Clinical Reasoning



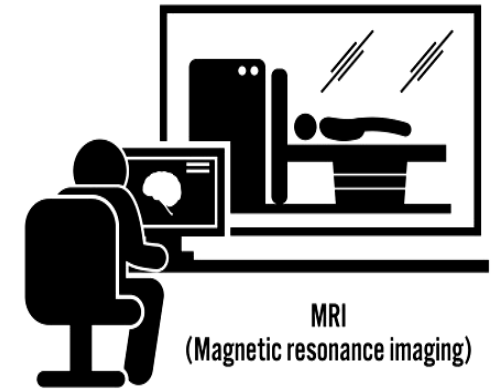
“The thinking and decision - making processes associated with clinical practice”



**History**



**Examination**



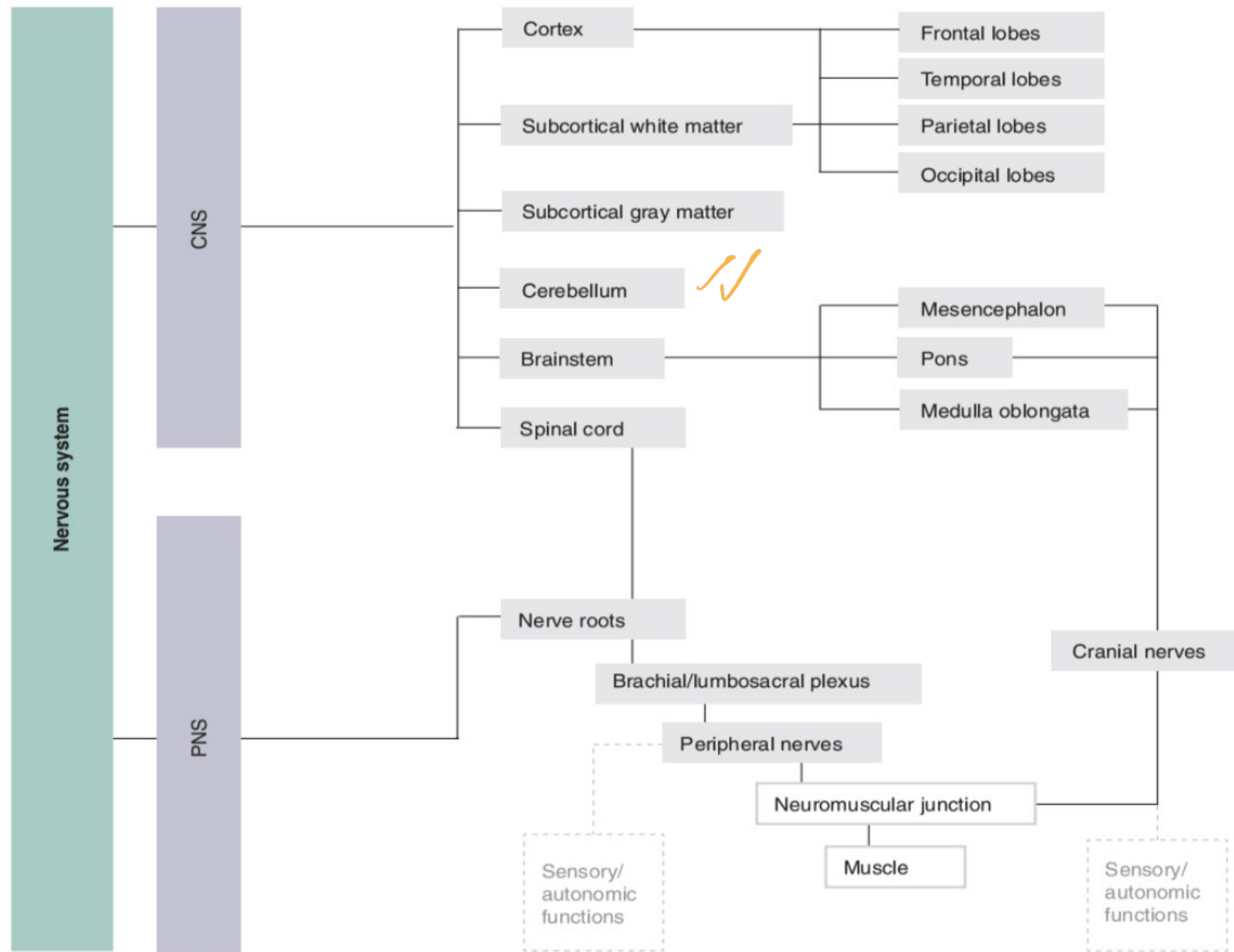
**Investigation**

**Where is the lesion?**

**What is the lesion?**



**Where is the lesion?**





**What is the lesion?**

**Congenital**

**Vascular**

**Traumatic**

**Tumors**

**Infections and inflammations**

**Toxin and drug induced**

**Deficiency and metabolic  
diseases**

**Demyelinating diseases**

**Degenerative diseases**

## Clinical vignette



A 35 year-old man presents with progressive gait abnormality

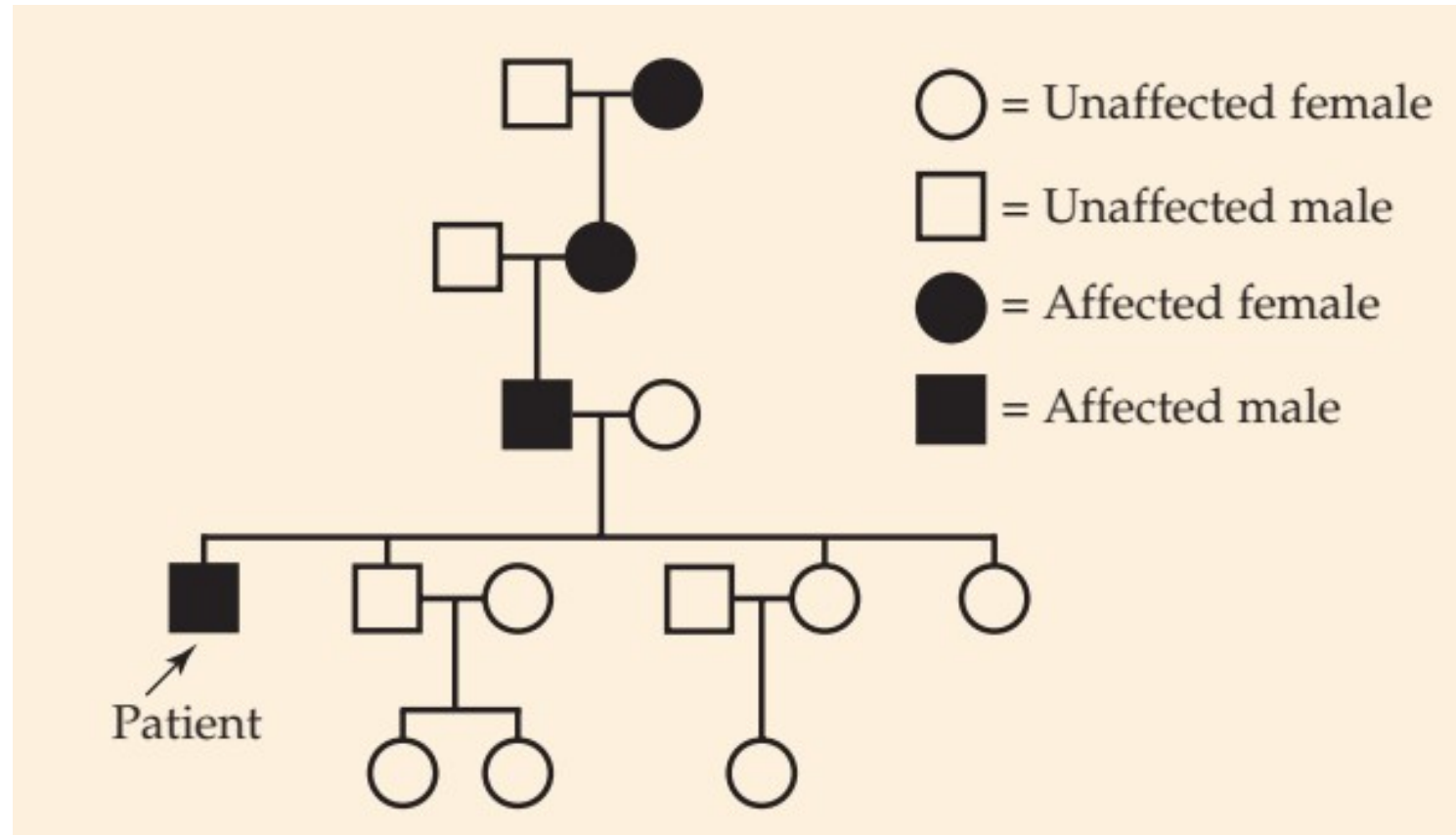
5 years ago he first noticed he “wasn’t doing well.” He developed difficulties with his coordination and balance, leading him to stop riding his bicycle, and he eventually stopped playing tennis.

His gait became progressively unsteady, causing him to have several falls and minor injuries.

# Clinical vignette

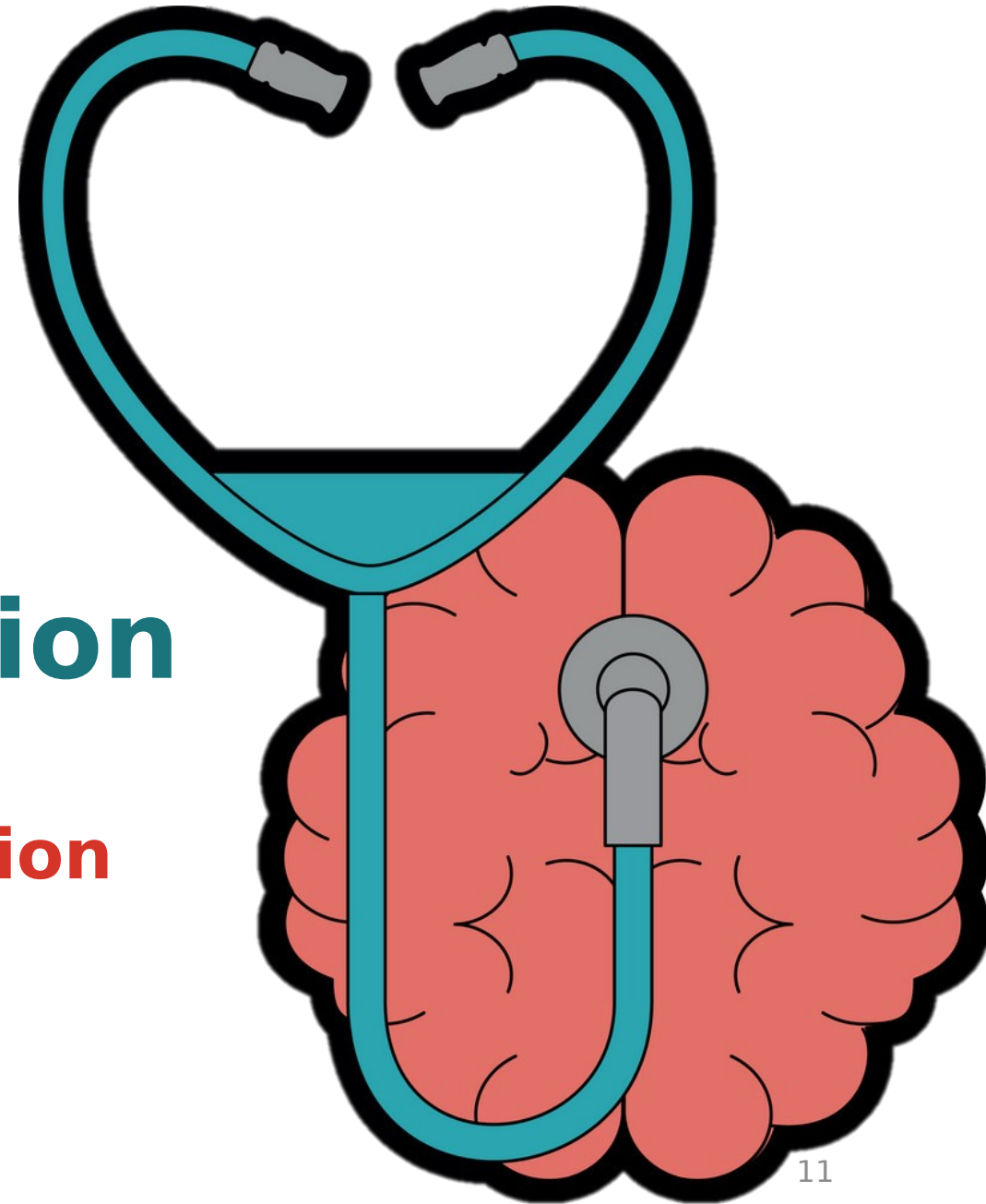


**His family history was positive for similar condition**



# Neurologic Examination

## Examination of cerebellar function

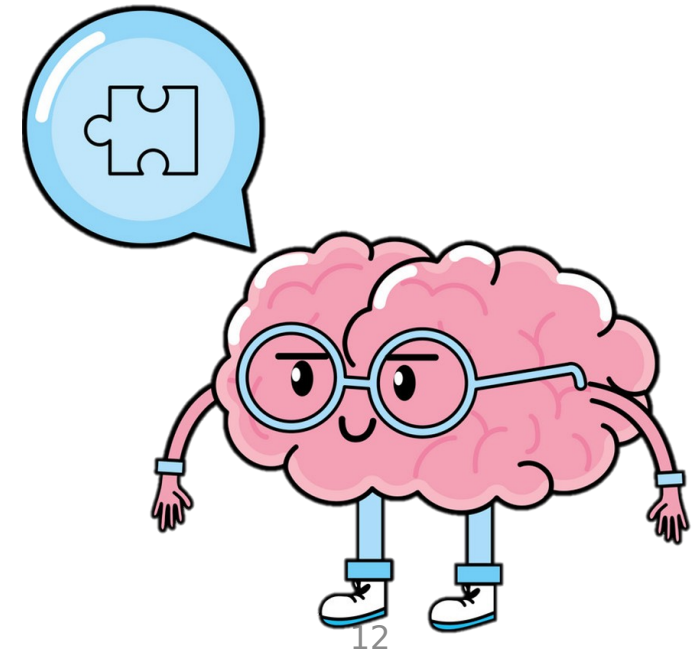


# How to assess cerebellar function?

**Tests of coordinated motor function**

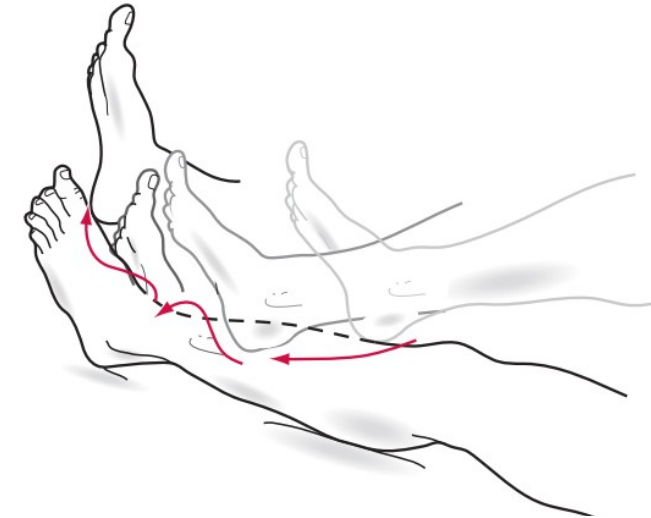
**Speech**

**Stance and gait examination**

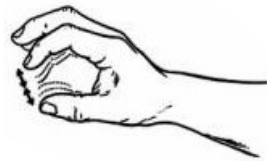
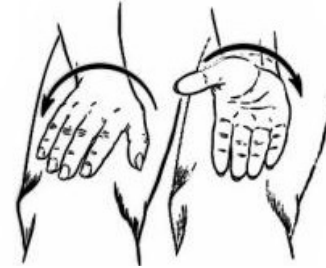


# Tests of coordinated motor function

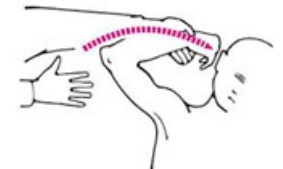
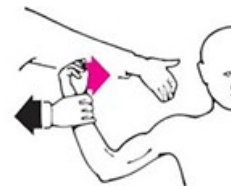
**Finger-to-nose and Heel-to-shin tests**



**Rapid alternating movements of the limbs**

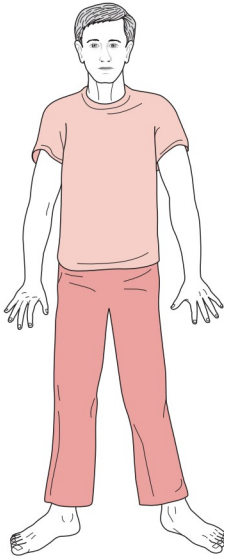
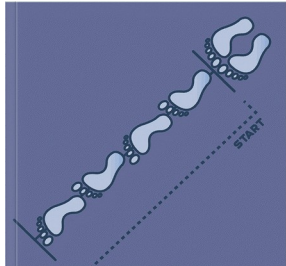


**Rebound phenomenon**



# Stance and gait examination

## Abnormal gait



Gait ataxia with "tandem" gait



# Speech examination

## Scanning speech



**Finger-to-  
nose**



**Heel to shin**



**Finger-to-  
nose**

**Heel to shin**

## **Dysmetria**

**Inappropriate rate, range, force and direction of movements.**  
**It results in:**

**Overshooting or past pointing**

**It is due to failure of damping & timing  
functions of the cerebellum**

**Finger-to-  
nose**

**Heel to shin**

## **Kinetic or intention tremors:**

**Are rhythmic involuntary movements, which occur during the performance of voluntary movements (movements oscillate back and forth at the intended point).**

**Cerebellar affection causes overshooting of the movement at the intended point, which cause the motor cortex to correct this overshooting by an opposite movement which again overshoot to the other side.**

# Rapid alternating movements UL



# Rapid alternating movements LL



# Rapid alternating movements

## Dysdiadochokinesia:

**The inability to perform rapid successive alternating movements e.g. supination and pronation of the forearm.**

**Failure of predictive & smooth progression function of the cerebellum**

# Rebound phenomenon



## Rebound phenomenon

### Rebound:

Thus if the patient is asked **to flex his forearm against resistance** and the resistance is suddenly removed, **the patient strikes his face.**

**Which is due to loss of the braking effect of the cerebellum.**

# Speech examination



# Speech examination

## Dysarthria:

Difficulty in **the coordination** of the highly skilled organised movements involved in speech, which becomes *slurred and decomposed* (staccato or scanning speech)

**Loss of coordination and smooth progression in the muscles of speech**

# Stance and gait examination



## Stance and gait examination

### Disturbance of gait:

**The gait is unsteady and the patient walks on a wide base in a zigzag manner with tendency to fall toward the affected side .**

**This is due to hypotonia and incoordination of voluntary movements**

In addition to the previous signs **which all occurs on the same side of the lesion** we may find:

## **Hypotonia:**

**Decreased muscle tone;**

**This results in a pendular knee jerk.**

**Because, normally the neocerebellum is facilitatory to the muscle tone**

**In addition to the previous signs we may find:**

**Decomposition of movement:**

**Which is the inability to perform various components of a complex motor act simultaneously (more than one joint)**

**Thus, the motor act is performed in steps.**

**Due to loss of smooth progression function of the cerebellum**

In addition to the previous signs we may find:

## Asynergia:

This is **failure** to perform **two synergistic motor acts** at the same time such as *flexion of the fingers* and *extension of the wrist*.

**Loss of coordinative function of the cerebellum**

**In addition to the previous signs we may find:**

## **Nystagmus:**

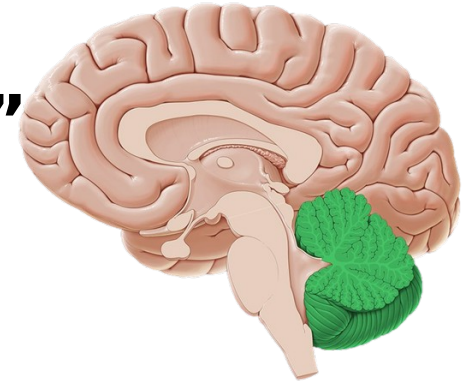
**Occurs when the subject attempts to **fix his eye on an object** to the side of his head.**

**It is also due to absence of the damping function.**

# Cerebellar ataxia

**Ataxia** literally means “absence of order”

It is clinical syndrome of incoordination



**Manifested as abnormalities in:**

## Coordinated motor function

- ☑ Intention tremors
- ☑ Dysmetria
- ☑ Dysdiadochokinesia
- ☑ Rebound

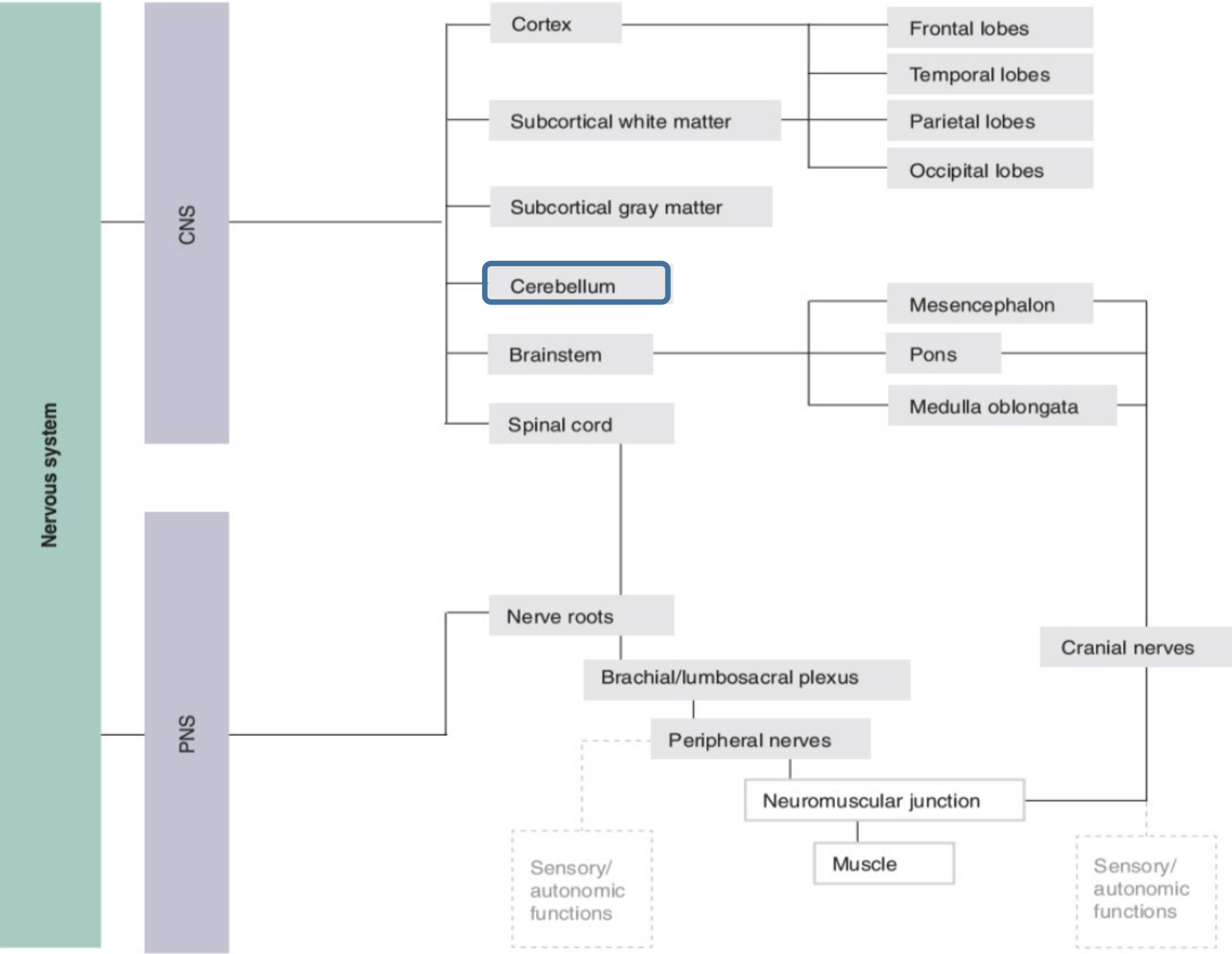
## Stance and gait

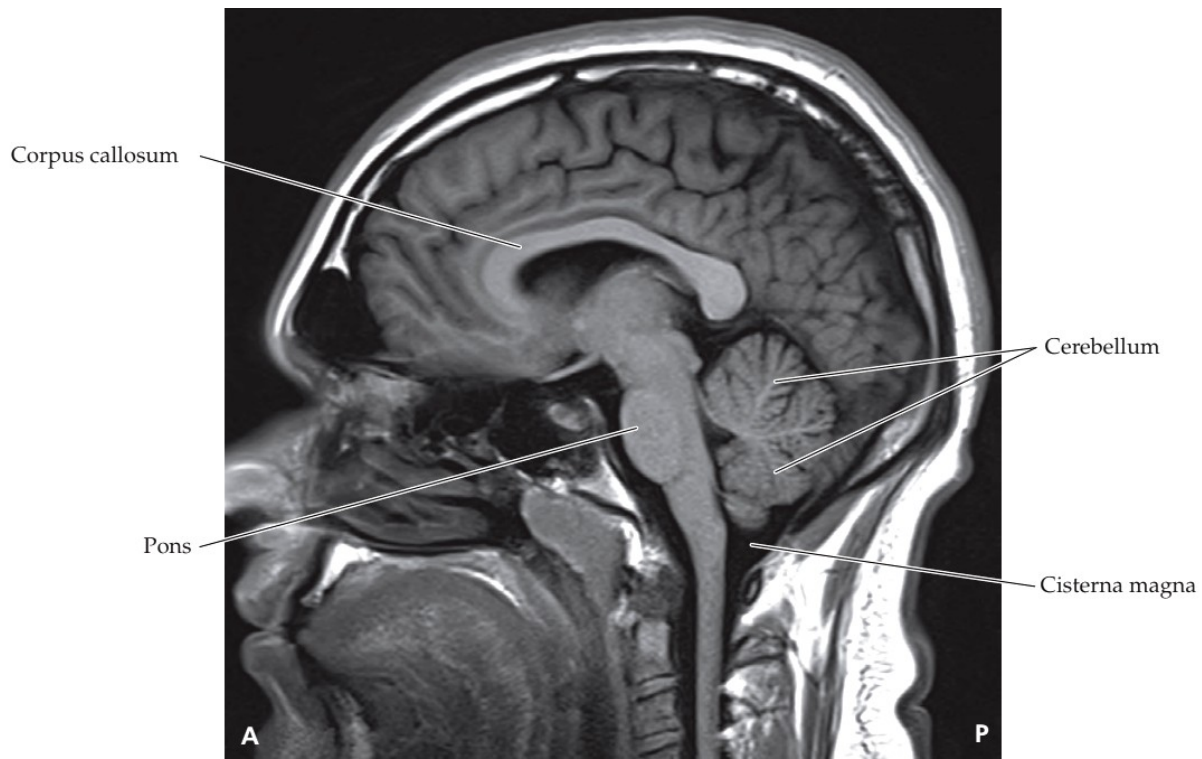
- ☑ Abnormal:  
Staggering gait

## Speech

- ☑ Dysarthria:  
Scanning speech

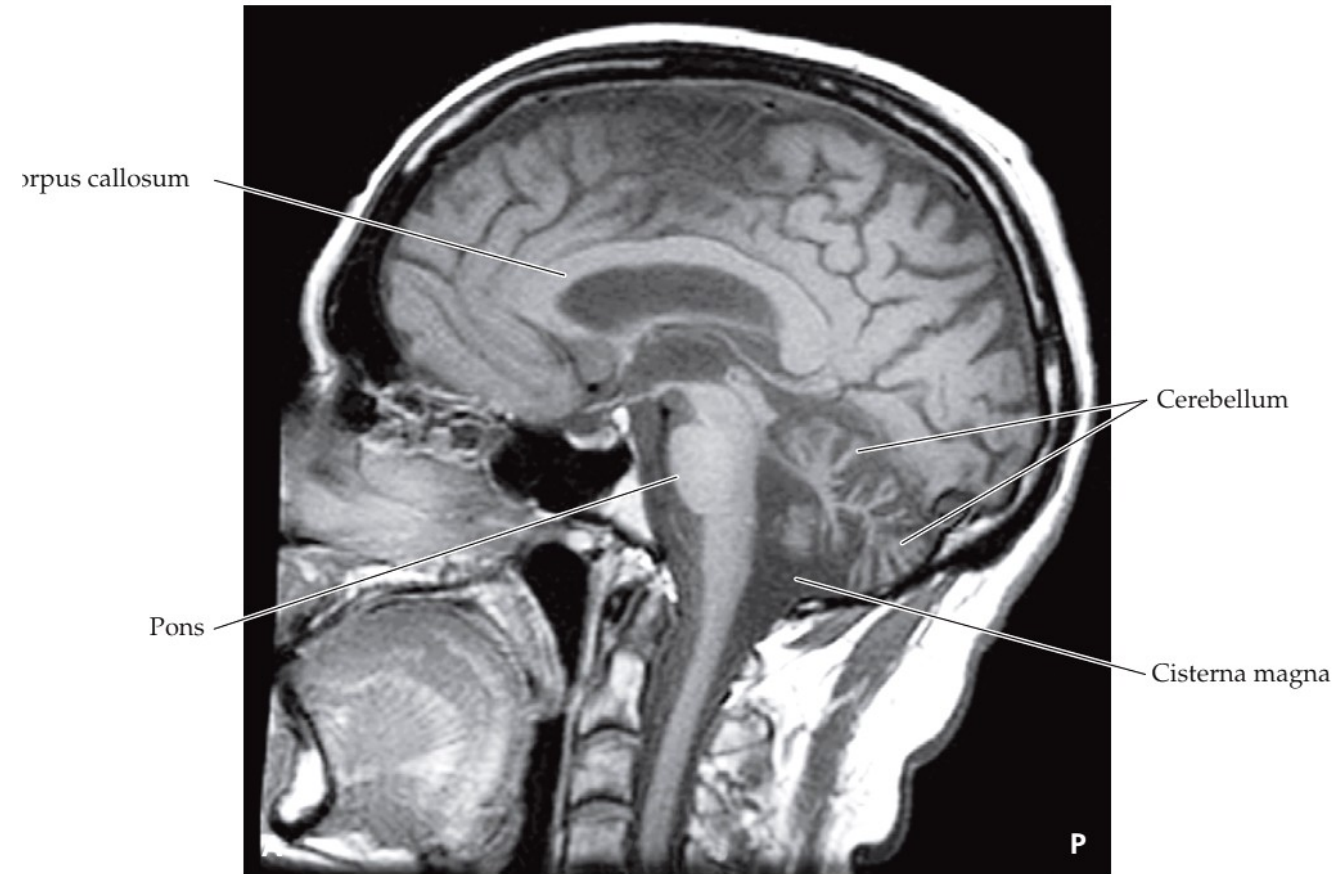
# Where is the lesion?





**Normal MRI**

## Cerebellar atrophy





**What is the lesion?**

**Congenital**

**Vascular disorders**

**Trauma**

**Tumors**

**Infections and inflammations**

**Toxic and drug induced**

**Deficiency, and metabolic  
disorders**

**Demyelinating diseases**

**Degenerative diseases**

## Clinical vignette



A 62-year-old man complained of painful tingling in the skin of both feet extended up to his mid leg, which started 2 years ago. since a few months his fingertips were also involved.

He experienced unsteadiness and falling attacks occurring at night and while he is washing his face.

## Clinical vignette



Neurological examination revealed a decrease of pain and tactile senses in the feet, whereas vibrations of a tuning fork were not recognized below the knees.

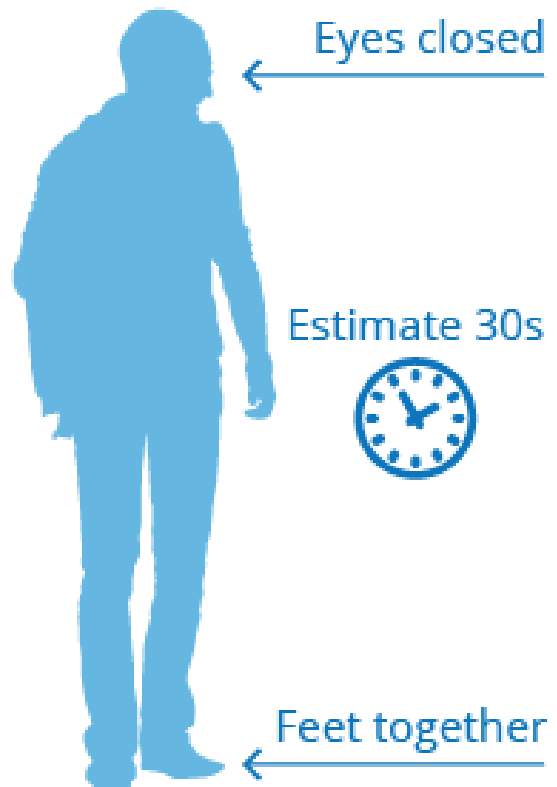
Muscle strength was normal and only the Achilles tendon reflexes were absent.

The **Romberg sign** was positive.

Gait was wide based and unsteady (staggering gait)

# Romberg test

## Romberg Balance Test





## A 62-year-old man presents with:

- ✓ Tingling in both feet progressed to involve the finger tips.
  - ✓ Loss of touch and pain sensation in these areas.
  - ✓ Loss of vibration sense below knees.
- 
- ✓ Ataxic gait
- 
- ✓ Positive Romberg test

**Sensory affection**

**Neuropathy**

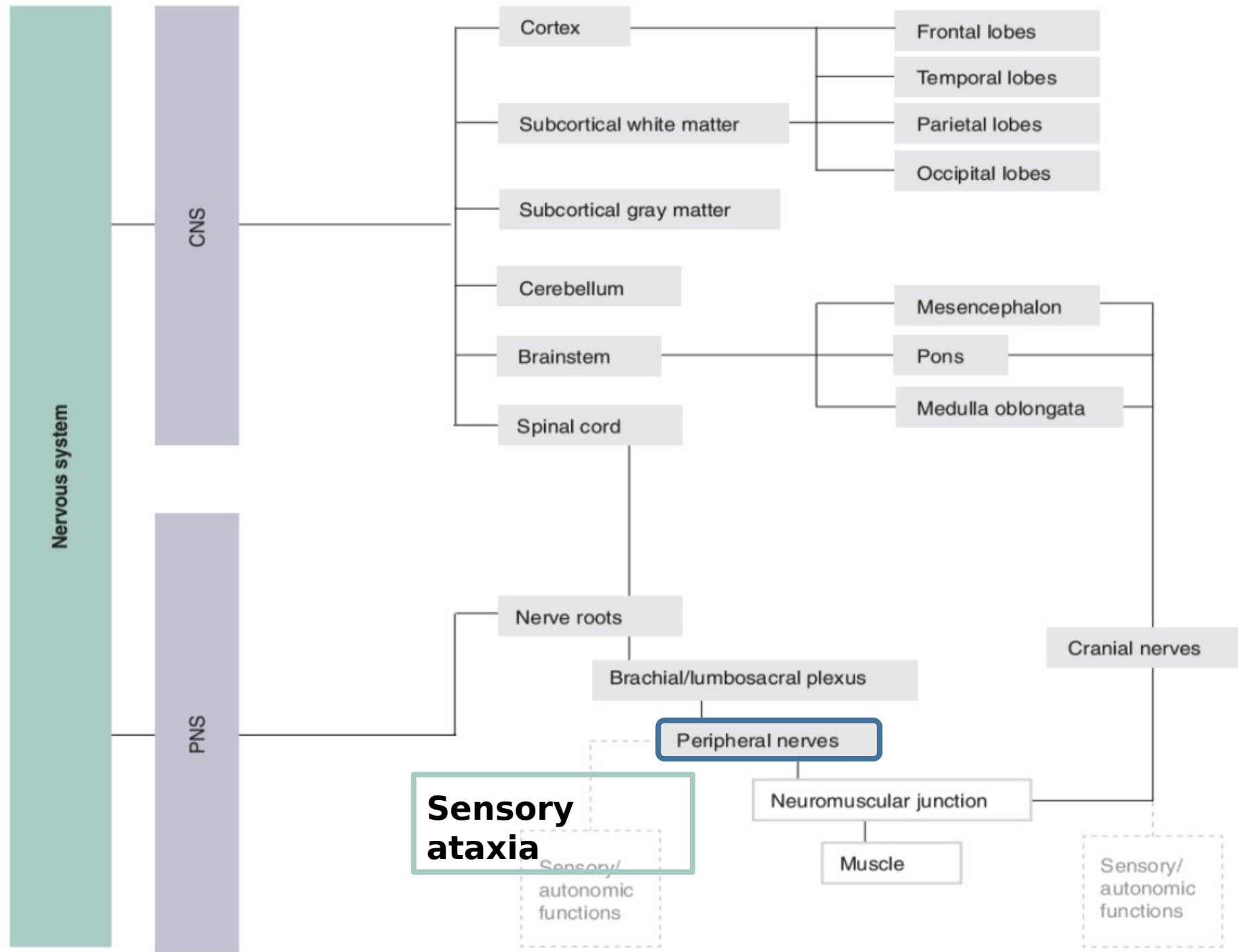


**Ataxia**



**Sensory  
Ataxia**

# Where is the lesion?



# Comparison between sensory and motor ataxia

	Sensory ataxia	Motor ataxia
<b>Most common cause</b>	Diabetic neuropathy	Cerebellar disease
<b>Gait</b>	High steppage (stamping gait)	Staggering (drunken gait)
<b>Romberg's sign</b>	Positive	Negative
<b>Effect of vision</b>	Corrected by vision	Not affected by vision
<b>Deep sensations</b>	Impaired or lost	Normal
<b>Tremors</b>	Absent	Kinetic tremors present
<b>Nystagmus</b>	Absent	Present
<b>Speech</b>	Normal	Scanning or staccato



# References



- Hall, J. E., & Guyton, A. C. **(2011). *Guyton and Hall textbook of medical physiology***. Philadelphia, PA: Saunders Elsevier.
- Barrett, K. E., Barman, S. M., Boitano, S., & Brooks, H. **(2015). *Ganong's Review of Medical Physiology 25th Edition***. New York: McGraw-Hill Medical Publishing Division.
- Le, T., Bhushan, V., Sochat, M., Kallianos, K., Chavda, Y., Zureick, A. H., & Kalani, M. **(2017). *First aid for the USMLE step 1***.
- Hauser, S. **(2016). *Harrison's neurology in clinical medicine***. New York : Mcgraw-Hill Education.



**Thank You**